SUPPLEMENT.

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FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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THE PRINCIPLES OF GEOLOGY.

series of general observations upon the igneous action at present going on the surface of the earth formed the subject of Prof. MORRIS's sixth e. With respect to the temperature of the surface of the earth, it is y derived from the sun and from the planetary bodies, the heat from tter source being comparatively inconsiderable. The surface temre varies in different countries, being highest near the equator, and ally diminishing as we proceed toward the poles; it is likewise modiy and dependent upon the relative position of land and water, the of the land, and its extension near or into the Arctic regions—thus at we observe a great difference in the mean temperature of places in the same parallel of latitude. The temperature of the British for example, is modified by their insular position, the influence of alf stream, and also by the winds passing over it. The influence of perficial heat penetrates, however, to a limited depth, at which it reconstant; this depth varies in amount in different districts where rations have been made. In the temperate zone the line of constant rature is about 60 or 70 feet from the surface, whilst at the equator y a few feet. Above this line the temperature varies at different of the year; below it, for a certain depth at least, it gradually in in proportion to the depth, giving evidence of the existence of an al source of heat, which will be more apparent from the study of the mena connected with or arising from volcanic action. The existence internal heat may also be inferred from the hot springs found in parts of the earth, from the salses, or so-called mud volcanoes, are often accompanied by gaseous exhalations, and, thirdly, from t number of active volcanoes and the nature of the mineral masses cted with or erupted from them. With regard to the increase of heat the line of constant temperature, numerous observations, both in e and in America, in mines, wells, &c., have proved that the heat es uniformly to a certain depth, but this ratio may not be continual. well at Grenelle it was found that the increase was 1° Fahr. in every a salt work in Westphalia 1° in 53 feet, in the deeper mines of y 1° in 76 feet, in the Monkwearmouth Colliery pit 1° in 60 feet, other localities, in wells from 1° in 50 feet to 1° in 70 feet, and this r the undertaking has been above or below the level of the sea. these grounds Cordier calculates that at the depth of 10,000 feet would be at boiling point, and that at 24 miles iron would be in a f fusion, and basalt and similar rocks perfectly fluid.

rmal springs are further indications of internal heat, more especially studied in connection with the localities in which they are found. rings abound in most regions of active volcanoes—near Naples for le, in Iceland, New Zealand, and in certain districts of North and America. These are also found in regions where volcanic activity g ceased, as, for instance, in the Auvergne, Germany, Hungary, ia, and on the Euganean hills in Italy, the chief sites of extinct . Thermal springs are also found along lines of fault, or at the f stratified with igneous rocks, in the Pyrenees and Alps, for le. They have been observed along anticlinal axes and faults, as coal regions of Virginia. Mud eruptions, which emit carburetted gen and other gases, occur in the Crimea, near the Caspian and Seas, in China, and in some parts of South America; gaseous exare likewise frequently met with in connection with hot springs. gh sometimes called volcanoes, it is better to consider them mud , as they are never accompanied by igneous matter, but only by tted hydrogen, and sometimes by bituminous products. As to volthey may be recorded as giving evidence of direct communication the interior and surface of the globe, being the vents through which, ostantly or periodically, ashes, cinders, and lava are ejected, and vapour expelled. Volcanoes are distributed over various parts of and occur principally near the sea, almost the only exceptions to being one of the Quito group, which is about 150 miles from the in Central Asia, where volcanoes are mentioned as occurring distance from the sea. As to the formation of volcanoes, they considered either as craters of elevation or as cones of eruption. , Elie de Beaumont, Daubeny, and other geologists have adthe former theory, which supposed the solid strata to have been into a more or less cone-like arrangement. This theory has, to given place to that of craters of eruption—viz., that the conis due to the gradual accumulation of scoria, ashes, and lava from the eruptive opening. This view, suggested by Saussure, orted by Hamilton, Dolomieu, and Breislac, has been clearly exby Mr. Poulett Scrope in 1821, whose work, "Considerations on " has scarcely received that attention from geologists it fully and also maintained by Sir Charles Lyell.

the nature of volcanoes, they may be divided into subaerial and ; of the latter class a striking instance was given in the elevation m's Island, in the Mediterranean, in 1831, but which shortly after ed. The subaerial volcanoes are divided into central and linear; being those which have a kind of central position within a ciritied disturbance, examples of which are found in Vesuvius, the Teyde, Teneriffe; Pico, in the Azores; Mowna Roa, in Hawaii; and probably Erebus, in the Antarctic regions. The linear are which the volcanic chain has a greater length than breadth, and is class that the great number of volcanoes belong. Iceland may entioned as having a linear series, then the Lipari Islands, and Sicily; the Lesser Antilles; the chain commencing in Fuego, extending along the western coast in Chili, Bolivia, and of Quito and Guatemala, and the central region of Mexico. ow the volcanic series of North-Western America, passing the Aleutian Islands, and continued southwardly through Kamthe Kurile Islands, the Philippine and Molucca Islands; the and Java (which probably for its limited area contains of volcanic action than any other part of the world), and extending through the Salomon Isles, New Hebrides, to New The number of volcanoes have been estimated by Mr. Daubeny 227, of which two-thirds in the region of the Pacific Ocean. in Central and South America belong to the higher peaks of two having an elevation of above 20,000 ft., and thus we see which modern volcanic action has been instrumental in the of the globe. To account for the nature of this action, the which result therefrom, different theories have both chemical and mechanical. Lemery and Breislac combustion of sulphur, petroleum, &c., produced the heat. the results to proceed from the effects of the permeation of water acting upon metallic bases of the earths and alkalies, a view still advocated by Daubeny, and not objected to by Bunsen.

The mechanical, or, perhaps, he should say the geological, theory would infer that steam being generated in the interior would, if not allowed to escape, in process of time acquire, so much heat and elasticity that it might press on the fluid matter below, and so bring about the effects. This is slightly in accordance with facts observed, since as well as gas, steam also accompanies volcanic eruptions. The eruptive matter probably having first found its way through some fissures finally reaches the surface. Generally speaking a volcanic cone consists of cinders, ashes, and lava, which have been gradually accumulated around the central opening or crater. Sometimes, however, the ejected matter is forced through an opening or line of fissure along the side of the cone, as in the recent case at Torre del Greco. The substances thrown out by volcanic action are not always the same; sometimes it is lava, at other times an eruption of ashes, cinders, and volcanic dust. It was matter of the latter kind that destroyed Pompeii, but that which destroyed Herculaneum was of a more lava-like character. Volcanic dust is frequently carried 200 or 300 miles from the volcano. Extinct volcanoes are those which have not given evidence of eruption in historical times; they occur in Auvergne, in the Eifel district, on the Rhine, near Olot in Catalonia, in some parts of Germany and Hungary, as well as in other parts of the globe. If we proceed in the investigation of igneous action at earlier dates in the British area, we shall find, in the tertiary period, the interstratified traps of the Island of Mullo, probably of meiocene age, and the basalt of the Giant's Causeway and Fingal's Cave, which was probably erupted after the chalk period. Proceeding backwards we find igneous rocks in the oolitic strata, as the dyke which extends from the coast of Yorkshire to the interior; and also in the Island of Skye, where there have been two eruptions—one at the period of the oolite, the other at that of the lias.

Igneous rocks are associated with the carboniferous series in Ireland, Derbyshire, Northumberland, and Scotland, also with the Devonian rocks in some parts of Scotland; and, lastly, we find distinct evidence of volcanic action in the trappean ash, contemporaneous with the formation of rocks of the Silurian period in Wales and in the South of Scotland, as well as others of a subsequent date. It will be noticed, therefore, that the igneous rocks occur both interbedded and intrusive—the latter having forced themselves through the strata already deposited. Hence it is easy to perceive the interest and importance of becoming impressed with recent volcanic phenomena, in order to understand similar phenomena presented at various geological periods; and thus showing how the study of the present assists us in unravelling the history of the past.

THE GEOLOGY OF THE BORDER.

Two very interesting papers have recently been read before the North of England Institute of Mining Engineers, which afford valuable information respecting the geology of the English and Scottish Borders. One is "On a Part of the Carboniferous or Mountain Limestone Series of North Northumberland," by Mr. E. F. Boyd, the treasurer of the Institute, and the other, "A Geological Paper on the Border Districts of Dumfriesshire, Cumberland, and Part of Roxburghshire, including the Coal Formation of Canonbie," &c., by Edmund Gibsone, of Penton, Longtown. Both these gentlemen are well qualified to deal with their respective subjects, and as the districts to which they immediately refer are not so familiarly known to geologists as are some other parts of the kingdom, we propose to give a summary of the facts contained in both papers. We may add that each paper is illustrated by plans and sections of enormous size, there being no fewer than 14 in Mr. Gibsone's paper, one of which measures 31 in. by 22 in., while Mr. Boyd's paper contains a dozen plans, sections, and plates, one of the former measuring 36 × 26 in., another 42 × 9 in., and a third 33 × 9 in., without allowing, in any case, for margin. We notice first Mr. Boyd's paper, which, by the way, would have been the better for a little editorial revision, and the attention of an experienced proof reader.

The district comprised in the paper read by Mr. BOYD may be nearly defined by commencing at the south bank of the Tweed, about three-quarters of a mile south of Berwick, and continuing by the edge of the high ground before descending to the River Till, past Berwick Hill, Shoreswood, and Felkington, through Greenlawalls, Gatherick, Etal, Ford, and Ford Moss to Doddington, Hetton, Holburn, Belford, and the sea; this being the line of outcrop of the lower portion of the mountain limestone or carboniferous series, classed by Prof. Phillips as the lowest portion of the upper Palæozoic strata. This limestone, Mr. Boyd tells us, displays almost all the ordinary characteristics which distinguish the mountain limestone series proper, but differs from the Derbyshire, Lancashire, and Yorkshire mountain limestone in being divided by beds of sandstone and shale, with part ironstone and fossil plants, and in containing numerous and valuable seams of coal. Its points of resemblance to other members of the series are as follows: First, The alternation of fossil remains: fossils are very abundant, though not to the same extent as in the ordinary coal measures, calamites, sigillaria, lepidodendra, and stigmaria, especially the latter, being most abundant. Secondly, in the numerous and extensive faults, dykes, or dislocations of the strata to which it is subject, "the circumstance of the course of these slip dykes being found in general to be at right angles to the main axis of elevation at the particular part of the district under consideration where they occur." These dykes are 15 or 16 in number, the principal being the Upright Basaltic Dyke, the Longy Heugh dyke of 109 fms., the Hetton dyke, 90 fms., and the Slainsfield dyke, of nearly 70 fms. Thirdly, this district assimilates itself to others in being intersected by the Upright Basaltic dyke above-mentioned, and by the extensive exposure on the surfaces of the Great Whin Sill, or stratified basalt. In his description of the Whin Sill Mr. Boyd expresses his agreement with Hutton that, although it is an intruder amongst such strata, there is little evidence to prove that it was actually *protruded between* beds already consolidated, and the appearances, so far as Mr. Boyd has been able to observe, favour Mr. Hutton's idea—in contradistinction to that of Prof. Sedgwick—"that this bed of basalt was produced by an overflowing of lava during the deposition of the mountain limestone, after those beds which are found below it, and prior to those above it." The direction of the Whin Sill is nearly N.N.E. from Heiton, in Westmorland, to Dunstanborough, where it disappears by east dip and denudation into the sea, to appear again, forming the Ferne Islands, but on its reappearance at Bamburgh (where, in the castle well there, it is about 90 ft. thick) it assumes a nearly west direction by Spindlestone to Belford, its course being marked by bold escarpments and irregular edges, as at Raven Crag and Boggle Houses. At the latter place, says the writer, "it presents the longest and loftiest exposed surface, being nearly a mile in length, and displaying on its western face 50 perpendicular feet, showing the prismatic and columnar arrangement; the large blocks and debris extend at an angle of 45° for more than 110 ft. further, making its perpendicular here probably 130 ft." Mr. Nicholas Wood and Mr. Hutton connect the northern extremity of the sill with the basaltic rock at Holy Island, but Mr. Boyd says he finds great difficulty in making out a continuous course for it from Kyloe to Holy Island, because the immediate *overlying* of it by successive beds of limestones, coals, shales, and freestones leads to the opinion that its further progress north was intercepted by the interference of the great Slip Rise Dyke to north; into the fissure and direction of which he conceives the whin or basaltic upright dyke running from Holy Island to Lennel, on the Tweed, to have obtruded itself. In describing the course of the Upright Basaltic Dyke, Mr. Boyd mentions a fact of some interest bearing upon the relative ages of the whin sills and basaltic and slip dykes, as follows:—"Near the point where the Duddo basaltic quarry is wrought there is known to exist a set of three slip dykes, or troubles, in the coal workings adjoining, and exactly at this place in the quarry the basalt is found to be shifted or removed sideways from its course (but without alteration of the width of the basalt) to the extent of 18 ft., or as far as 30 ft., according to the influence or power of the interfering slip dyke pursuing immediately after its original direction. If, then, the epoch of the upheaving of the Upright Basaltic Dyke may be conceived to be more recent than the deposition of the Whin Sill—which its extra igneous effect on the adjoining strata leads one to imagine—and if coeval with, or very recently subsequent to the date of the other slip dykes around it, it would, indeed, be interesting to have been allowed the opportunity of seeing whether it would have, in a similar manner, penetrated through the whin sill, or what other effect it would have produced upon it."

Mr. Boyd then proceeds to enumerate the strata of the district, and the list, which appears to be very complete, occupies five closely printed pages. In the aggregate there are 15 fms. of coal, 46 fms. 1 ft. 6 in. of calcareous deposits, and 545 fms. 3 ft. 6 in. of other deposits, giving a total thickness of 606 fms. 5 ft. Then follows a description of the workable seams of coal in the district, and as these are but little known we shall briefly condense the information which Mr. Boyd supplies concerning them. The Rough coal is the highest workable seam in the series of the Lowick district. It is about 1 ft. 8 in. thick, and being, as its name implies, of coarse quality, only fit for lime burning, it is wrought merely to prolong the duration of the seam below it. The Licker coal is with partings 2 ft. 6 in. thick, and has a roof of strong blue metal. It is sold as a landsale coal, and is the only seam of importance overlying the thick strata of upper limestones of the general section, being about 13 fms. above the uppermost of them. It is highly bituminous in some of its layers, but leaves a large residium of white ash after burning. The Greenses or Allerdean coal is a coarse coal, with a roof of red freestone. It is 2½ ft. thick, and lies about 6 fms. below the Oxford limestone. The Muckle Howgate, and Little Howgate seams are, the former about 3 ft., and the latter 2 ft. 2 in. thick, and are respectively 12 and 40 fms. above the Woodend limestone. The produce of these seams is in much demand for burning the rich accompanying deposits of lime. The Caldside or Fawcett coal is usually from 2½ to 3 ft. thick, and occurs about 40 fms. below the Woodend limestone. It is a fair bituminous, though not very rich coal, suitable for household landsale. The Scremerston Main or Black Hill seam is about 90 fms. below the Little Howgate seam. The usual section is from 2 ft. 4 in. to 2 ft. 8 in. of good coal, and from 6 in. to 1 ft. 3 in. of ground coal; near the bottom of the seam is sometimes found a brassy band, and occasionally a coarse coal between the top and ground coals, increasing to band of from 6 to 9 in. thickness. The annual output at Scremerston Colliery is about 25,000 tons. The Stony coal, or Hardy seam, is an indifferent one, being hard, and coarse burning. An ordinary section shows 9 in. coal, 9 in. stone bands, 1 ft. 2 in. of good middle coal, 1 ft. 2 in. of bastard limestone bands, and 9 in. of bottom coal—rich and bituminous. It has a hard thill for kirving, which, along with the thickening of the band, creates obstacles to its extensive working. The Cancer coal of Berwick Hill, Bulman coal of Murton, and Main coal of Thornton, Shoreswood, &c, is, by reason of its splinty character, an excellent steam-raising coal, and but for its tender shale roof would be more extensively worked. It is usually composed of top coal, 1 ft.; chalkstone, 1 in.; fine splint, 1 ft.; rough or coarse coal, 7 in.; band, 1 ft. 8 in.; good coal, 1 ft. 6 in.; chalkstone, 1 in.; bottom or smithy coal, 4 in. The Three-Quarter coal, is 3 ft. thick, containing 4 in. of band and 6 in. of coarse grey coal. The roof is of blue shale, and the kirving is made in the shale below. At present this coal is not worked, although were it not for its heavy laborage payments, and difficult roofstone, it would, by reason of bearing well the effects of weather and carriage, prove a valuable adjunct to the household and steam purposes of the district. The Cooper Eye—the principal seam of the series—lies about 20 fms. below the Bulman or Cancer coal, its roof being of bastard limestone. It comprises 1 ft. 3 in. of splinty top coal, 9 in. of macker—which will burn, but with large residium—and 1 ft. 3 in. of ground coal, and is very liable to undergo the process of "nip out," sometimes disappearing for as far as 250 yards. This coal forms the supply of the Shoreswood and Felkington Collieries to the extent of about 21,000 tons annually. Its appearance when wrought is large and square; is highly bituminous, and although leaving, as all the coals of this series do, a white residium, burns with a bright flame, and possesses considerable lasting properties. The "Macker," which occupies the centre of this seam, increases 2½ and 3 ft. in the north, as at Berwick Hill; in the south it somewhat diminishes. The last of the series of coal seams in this district is the Wester coal, lying about 10 fms. below the Cooper Eye, with a roof of blue shale. Up to the present time it has not been extensively sought after, but at Felkington New Colliery the section shows 2 ft. 2 in. of coal, 1 ft. 6 in. of limestone band, 7 in. of coal, 3 ft. of blue shale band, and 10 in. of coal.

The method of working the coal in this neighbourhood differs from that generally adopted in the northern coal field, it being wrought on the "long wall" system, which has been handed down from very ancient times. The wall face is divided amongst the workmen to the extent of 10, 12, or 15 yds. to each man, according to the thickness or hardness of the seam. The very general existence of strong limestone bands, which to a manager of bord and pillar working would be a marked and almost insurmountable difficulty, is here, says Mr. Boyd, hailed as a powerful ally in forming the front edge, even with considerable intervals of the pillar behind (about 4 or 4½ ft.) the workmen, between and behind which pillars the stowing or "gob" is effected, as best as it can, by the other refuse or kirving material made and met with in the working. Where these bands are absent, or not strong enough to form pillars, recourse is frequently had to a portion of the roofstone, the last alternative being the employment of strong timbering, not expected to be again drawn or used. The moistening of the particles of iron pyrites stowed away with the rubbish is sufficient to alter its condition from the state of sulphuret to that of sulphate of iron, the decomposition of which frequently causes considerable increase of temperature, and the discharge of a strong and stifling odour, otherwise the ventilation is not difficult to maintain, the extent of run or traverse of the air being, in no case, very great, and the face and water levels being easily accessible.

Mr. Boyd concludes his paper by conducting the reader over the district in the character of an itinerary, pointing out the geological features of the country side, and entering more minutely than at the commencement into the position and influence of the dykes and faults. On the last page but one he puts the following questions, which some of our readers along the Border may, perhaps, be able to answer:—"Whether throughout the whole range of its (the Whin Sill) appearance from Kyloe to Cumberland, it is always invariably overlaid and underlaid by the same strata, or geologically occupies the same position relative to the district in which it occurs? And whether the perpendicular basaltic dyke to the north of Kyloe penetrated through and severed the whin sill, as it did the other strata; or whether their protrusion was coeval, and that they amalgamated in the fused state?"

MR. GIBSONE'S PAPER.—When the paper contributed by Mr. Gibsone was read before the Institute, Mr. Boyd, the author of the essay which we have just epitomised, said he had never met with more illustrative and practical geological observations in any book or paper than those made by Mr. Gibsone. To a certain extent we endorse this opinion. The paper is really a very valuable one, containing announcements of several geological discoveries, and bearing throughout marks of the careful and scientific observer.

The scene of Mr. Gibsone's explorations is from the head of Liddesdale, around Langholm to midway between Annan and Dumfries, and then away east and north-east along the borders of Cumberland and Northumberland. The paper contains a brief description of the Silurians and old red sandstone, the carboniferous limestone group, the coal formation and Permian strata, or new red sandstone. Details are also given of the most remarkable igneous rocks or trap-dykes and faults met with in each class of strata. The writer tells us that every district has been carefully investigated on the spot, the boundaries of each group marked, as exactly as the ground would admit, and as a subject interesting to mining engineers the situation in the district where any attempt to find antimony, lead, coal, or ironstone has been made (and these mineral trials are not few or far between) are pointed out on one of the maps. Commencing with the Silurians, Mr. Gibsone tells us that the slate, which, although used for building purposes, is not the roofing slate proper, is seen in Liddesdale a little above Peel Fell, skirts round by Arnton Hill, and appears again near Sandhopeburn, Mosspeeble, Langholm Bridge, Torbeckhill, and Dalston. The Silurians are all very much inclined in their lamina or beds—sometimes contorted. They generally have the dip to the south, and in the northern part of the district igneous rocks or dykes occur. A common section shows a a thick stratum of soft slate near the old red sandstone of a pale green tint; the hard is also met with near the old red, of a pale greyish blue colour, and a harder, of a deeper blue, is sometimes seen, but the slates are generally fine grained, with veins of quartz and calcareous spar. Lead trials have been made in Grange Fell, Hazelberry Hill, and Westwater, and antimony has been met with near Crawthwaits Hill and Glendinning, above Langholm. At Glendinning it was wrought from 1793 to 1798, and produced 100 tons regulus of antimony, the width of vein being from 5 to 20 in., containing antimony, lead, and a little silver. The old red sandstone rests upon the previously disturbed Silurians, and is characterised by an infinite variety of colours and great difference of quality or composition. The lowest rock seen is a dusky brown, red gritty, but soft, sandstone, of great thickness enclosing rounded quartz pebbles. Others succeed which contain water-worn pieces of slate, brown and blue; then come finer brown sandstones, some of them highly micaceous, and these are followed by pink, white, and yellow sandstones, divided by layers of soft crumbling clays. Mr. Gibsone states that the only fossil he has found in the old red here was a calamite, converted into coal, and not a very sharp impression. Three attempts have been made to find coal in the old red series of this district—one at Castlemilk, in 1791; another at Linnbridge Ford, where a thin seam of coal was found, and the third at Limekiln Edge, where a streak of coal was said to have been met with. Two trials for lead have been made in this group by short narrow drifts, near the trap-dykes at Torbeckhill and Roanfell. The lower series of carboniferous limestones generally commence with dark, thin, and poor

limestones; hard, yellowish, brown sandstones; black, dark grey, and blue shales; and are followed by limestones, shales, and sandstones, with thin seams of coal, and coarse yellow sandstones forming the floor of the coal formation. At Limekiln Edge old quarries the rock is intermixed with pure grains of crystallised calc-spar, and some of the cavities are lined with crystals of red-coloured calcareous spar. These limestones Mr. Gibsone says he has not met with anywhere else. Three wells are in the formation, having "an ancient and fish-like smell," being of the usual sulphureous character. Several seams of coal occur between the lower and upper series of limestones, varying in thickness from a few inches to one or two feet, while the shales become thicker and the sandstones of finer grain. The principal stratum of the upper series now working is fully 30 ft. thick, with a 4-ft. post of limestone and a 10-in. seam of coal a little below. Some of the series have a conglomerate tendency, as at Haythwaite Burn and Springkell; in others the layers of post are divided by a green-coloured clay, and the whole series, upper and lower, give evidence of the powerful force exercised to raise, depress, and fold them over at its will. Taken as a whole, the old red sandstone and the carboniferous limestone of this district bear a resemblance to the Irish and South Wales groups.

"Many attempts," says Mr. Gibsone, "have been made to find a thick seam of coal in the limestone group, but hitherto without success." Thin seams have been met with at Aiket Muir, Hedom, Kelhead, Knockhill, Ecclefechanburn, Chapelhill, Springkell, Liddisdale, Bellsburn, Tweedenheadburn, Nichol Forest, Cumberland, and over towards Linewater. On Liddelbank many bore-holes have been made, and it is affirmed by one of the borers that one of them found a seam 5 ft. thick (but the journal is lost) 50 fms. from the surface. "For many years a small colliery there worked out a thin seam, about 1 ft. 6 in., and below it a 2-ft. seam is still unworked. On the south of the Liddel also is a 2-ft. seam. The 10-in. coal, below the 30-ft. limestone of Petersceuch, was also worked in old times by day level, 150 yards by 120 yards of wall-face. In the Hagginburn, head of Carwinlayburn, Cumberland, two thin seams, on edge, were formerly worked, also a little pit for a thin seam and coarse Cannel. Of all these trials and little collieries, going, perhaps, 30 or 40 years ago, only one continues to be worked—at Oakshaw, in Newcastle, by a long day level. The quantity of coals raised is about 2700 tons, 1½ ton being the collier's shift. The rent is from 60*l.* to 100*l.* yearly. At Hagbeck, Solport, the following seam was at one time worked:—Shale, 8 fms.; coal, 1 ft.; white freestone, 3 fms. 5 ft.; shale and freestone, 1 fm. 3 ft.; coal, 6 in.; bluestone, 4 in.; coal, 7 in. A trial for ironstone was made two or three years ago, near the coal pit at Linewater, but I saw nothing to justify it: a blood-red sandstone may have been mistaken for hematite. A little lead ore is found in the joints of a vertical limestone in the Blackburn, near Newcastleton." Mr. Gibsone next proceeds to deal with the coal formation, into a description of which he enters at great length, affording information of a most interesting and valuable character. He describes the lower seams as resting upon a thick stratum of black shale and white and yellow sandstones, overlying a 4-ft. post of impure limestones a conglomerate post, and a thick series of sandstones and dark shales, the entire group corresponding to the millstone grit of some of the English series, and bearing no relation to the central Scotch coal fields. At Byreburn they contain large balls of ironstone, yielding 30 per cent. of cast-iron, and in Fenton cutting is a 4-in. band of the kidney hematite in blue shale. The series has suffered greatly from denudation, and only portions of the seams are found in a stretch of four miles. The seams which yield coal of a tolerably good quality are three in number. First, the lime coal seam, having about 10 in. of coal above and below about 8 in. of dark-stone: 20 fathoms up is the Three-Quarter seam, 2 ft. 9 in. thick. About 4 fms. higher is the Main coal, consisting of upper bed (sometimes wanting), 1 ft. 7 in.; blue metal, 9 in.; bottom coal, 3 ft. These seams were wrought at Byreburn, at little or no profit, by means of water-bucket engine and winding water-wheels, until a fall occurred through leaving too small pillars, and the burn broke into the workings." At Hollows Bridge is a small Roman fort, in a sort of angle formed by two steep rocks facing the water, and a deep ditch has been cut for defending the other side, with the usual military bank. On digging into this ditch I found the coal cut out, as well as the covering soil, and there can be little doubt that the old Roman soldiers worked and burned the coals during their weary and cold stay." Between the upper strata of the lower series of coal formation and the thick coal series Mr. Gibsone tells us that a space occurs, the exact depth of which is not definitely known, but a bore put down 30 fms. from the lowest workable seam of the thick, or upper series, found only thin seams of coal. The seams in the upper group are 13 in number, yielding a good household coal, of a coking quality. Some of them contain splint, which works large, and is a powerful steam coal, and altogether they resemble, generally, the East and West Cumberland and some of the North Lancashire coals. The lowest seam of the group is the Seven-Feet seam; then 2 fms. 3 ft. of fire-clay; then the Five-Feet seam, divided by two thin ribs of stone and clay; then about 11 fathoms of white sandstone; then the 5 feet 6 inches seam, about 11 fathoms of sandstones and shales brings the series belonging to the Eleven-Feet seam, with roof of blue soft shale, followed by the Six-Feet seam, or Old Main coal, and then the Four-Feet seam, or Three-Quarter, there being from the top to the bottom of this group 47 feet of coal, the thinnest seam being two inches in thickness, and the largest 11 feet thick, divided at the bottom by 1 ft. of clay and then 2 ft. of coal, making in all seven seams of workable coal, amounting to 40 ft. 6 in., without including the millstone grit." The area is, however, very limited, and the seams are much disturbed by faults. No ironstone or Cannel coal worthy of notice has been found amongst them, nor is it likely that there ever will be. Fossils abound, and in the Eleven-Feet seam numerous fossil trees have been met with from 20 to 30 ft. long, pressed flat, and almost invariably lying in a north-east direction. From the absence of strata of carboniferous limestone, intermixed with the coal seams, as is the case in Cumberland and the central coal field of Scotland, Mr. Gibsone assigns an earlier date to the Cumberland and Scotch formations. Passing on to the Permian series Mr. Gibsone states that "there is nothing but a regular passage from the coal to the Permian beds," so that, so far as that part of the kingdom is concerned, he feels disposed to "drop the term lower new red sandstone, as conveying an idea that two different formations lie above the coal or carboniferous strata." The Permian district, taking Longtown as its centre, is a thick stratum of brown red, with a little white sandstone, succeeded by a deep-coloured clay, containing thin veins of gypsum, and in Carwinlayburn a coarse patch of a yellowish colour, containing very small rounded pieces of lime, shale, and Silurian slate. At Comlongan Castle, beyond Annan, a conglomerate bed is met with, containing angular and rounded fragments of slate, and pieces of granite with red brown sandstone. A red clay is next exposed, containing thin bands of sandstone, and having brown limestone about 10 in. thick, in the form of balls or lumps. On the south side of the Liddel a thick stratum of light grey sandstone is seen slowly rising towards Penton. Below this is a thick stratum of variegated clay, brown and bluish white, with green; then follows the brown red sandstone, in which the Netherby bore commences, about ¼ mile from the Canonbie coal field. For a description of this bore, and the beautiful sections illustrative of this part of the subject, we must refer the reader to the paper itself, merely adding that Mr. Gibsone furnishes excellent reasons for supposing that a valuable coal field lies below the Permian formation to the south and south-east of Canonbie Colliery. "That the Permian beds originally covered the Canonbie coal field," Mr. Gibsone affirms, "cannot be doubted, and a portion of these, with some of the coal measures removed before or during the deposition of the drift-sand." He thinks that the best way to find the coal is by boring near the exposed coal measures, as has been done very successfully near Manchester. At the same time, he remarks that the resemblance between the Permian beds of that district and those of Canonbie is not a close one, while they have little or no resemblance at all to the Permian strata of Durham, Nottinghamshire, &c. The quantity of clay in them makes the strata very free from water, and Mr. Gibsone calculates that one square mile of the upper series would yield 200,000 tons yearly for 150 years.

We have scarcely sufficient space at disposal to do more than give an outline of the very interesting chapter on trap-dykes and faults. One dyke commences at Windburghill, a little beyond the Head of Liddesdale, and extends south-west of Dalton. It occasionally changes from greenstone to basalt, and greenstone porphyry, and at Langholm hill and Burnswarkhill it is amygdaloidal, containing almond-shaped holes, being the bubbles of gas in the irrupted lava relieved from pressure. In other places the greenstone is accompanied by trappean conglomerate, containing pieces of white sandstone 2 ft. long, pieces of black shale, white limestone, and fragments of red and blue slate. A sort of branch of this dyke crosses from Roan Fell, Tinnishill, to near Springkell, where it disappears in the Permian. It is a greenstone accompanied by volcanic ash; in fact, Tinnishill (one of the bearing points in the marine maps of Solway Frith) is entirely composed of ash on the outside, "as if showers of ashes had been first blown up from the interior of the fissures, followed by the molten trap, and the tuff consolidated round about under water." The coal field is cut off to the north of Byreburn by a large fault, moving in a south-west direction between the millstone grit and the limestones; and one in the same direction is seen in Carwinlay Burn, "but the strata turns round towards Brampton as it closes on the Permian strata, each post being left behind, and hence it is impossible to say if the coal formation goes on towards there, or the Permian strata overspreads strata like that in Bewcastle. One thing is evident in the geological movements of this district—that an upheaval of the different formations towards the east slowly went on, bending the beds upwards, possibly without much disturbance; that afterwards large areas were cracked by movements in the earth's crust, and the molten trap flowed up like mud in some places, and in others, being more confined, pressed upwards and tilted the strata near them, that some portions of the district were lifted up, other parts were not so much so, and these were the cracks or fissures formed like the letter V to each other, and the other areas formed like the letter A between the trap-dykes that portion of the strata would be level: but A being raised from below would drive the others to every shade of inclination, until the various broken time-hardened stratification reached the wave line of the sea, and then by the work of denudation, the currents and ice deporting the water-worn rocks and soft materials from them in every direction in accordance therewith." This is not very neatly expressed, but we hope it will be understood, for it gives a very satisfactory account of the manifestations of geological force which attract the attention of the practical observer in a stroll through the locality. Mr. Gibsone concludes by describing a very remarkable ridge of gravel about three quarters of a mile long, and about 20 feet in height, round at the top, and in shape like some old military embankment, covered with a thin green sod; it is composed of small pieces of sandstone, slate, and granite, and an odd bit or two of coal. Mr. Gibsone accounts for its presence in this district as follows:—When the strata of the district were raised to its present level the sea washed off portions of the old red, &c., and the carboniferous limestone, millstone grit, coal measures, and Permian strata raised up, crushed, and soft to what they are now, were rolled and tumbled about in a shallow sea, and the clay carried forward, as being light and easier floated. Masses of ice carried the larger stones, and the granite and limestone boulders, and dropped them as it yielded to the influence of summer heat, while the sand was formed into layers by the flow of the water. A small glacier also was formed round the hill tops in the upper part of Liddel Valley. The level of the sea was then gradually lowered, and the flowing currents washed away considerable portions of the boulder clay and sand layers, leaving the country as it now is. The granite boulders are from Criffelhill, near Dumfries, and are all rounded, and masses of ice would easily be floated with them towards Langholm and Liddesdale. Thus Mr. Gibsone believes that "the drift here was formed towards the close of the glacial period; that no movement of a local nature took place after the deposition of the drift, as the sand layers are level, and the dykes and faults do not thrust up points of rocks through the clay till or sands; that the sea level gradually fell from the top of the heights by the sinking at the bottom of the Atlantic, being the compensating movement for the previous upheavings in the district under survey. He who, as it were, held the hills in a balance, and regarded the isles as a very little thing, said to the sea 'Hither shalt thou come and no further,' and the trembling strata remains at rest to this day."

In conclusion, we must express our regret that the Northern Mining Institute does not submit its papers to some kind of literary revision. The paper before us, like that of Mr. Boyd, would have been greatly improved if some person accustomed to prepare documents for the press had gone carefully over it, either in the MS. or the proof-sheets, shortening the paragraphs, and introducing a proper system of punctuation.

ROLLING IRON.—In order to produce a finished plate or bar of great size in less time than usual, and whilst the metal is nearer a welding heat, Mr. John Napier, of Glasgow, proposes to arrange two or more pairs of rolls at suitable distances apart, so that the pile of metal to be operated upon may pass onward through any requisite numbers of pairs of rolls placed in succession, and all in about the same direction, the first pair being like the ordinary roughing rolls, and the last pair suitable for bringing the plate down to the finished size. Each of the different pairs of rolls are driven by distinct engines, each being separately governed or regulated to give the required speed, so that in the process of rolling the plate, bar, &c., may be passing through one, two, or more pairs of rolls at the same time, the speed of each pair of rolls being such as is necessary to compensate for the extension or elongation of the plate as it passes from one pair of rolls to another. Instead of using separate steam-engines to each pair of rolls, gearing, and conical drums and belts for varying the speed, may be used. To allow as much as possible scoriæ or gases that may be lodged in the heart of the mass to escape, he makes the centre of the first pair of rolls of larger diameter than the ends, the second pair of similar form, but with less difference between the centre and the ends, and so on reducing the difference until the last pair of rolls turns out the finished plate of the required size and shape. By this arrangement the scoriæ, gases, and other extraneous matters may be expelled from the plate while the metal is at or near the welding point, and thereby blistering or other unsoundness in the plate, bar, or other manufactured article is more effectually got rid of. In combination with this arrangement, Mr. Napier proposes to use vertical or oblique rolls, to give the metal any required shape.

ON WINDING.

[Transactions of the Miners' Association of Cornwall and Devon.]

The paper was illustrated by drawings, contributed by Mr. Lancaster, a mining engineer, of the Kirkless Hall Collieries, near Wigan, which displayed the winding machinery in use at some of the collieries.

Although this subject has been twice brought under the notice of this Association, there are still points to which attention should be more strongly directed than it has hitherto been, and which have the most important bearing on the relative merits of any particular plan for winding. The most important, it appears to me, is the proportion between the dead weight and the quantity of stuff drawn. By "dead weight," I mean, of course, the weight of the skip and the rope and chain that are connected to it in the shaft; in deep mines the dead weight must be more than in shallow, and the cost of drawing proportionately higher. Thus, if 6d. per ton would pay for drawing 100 fms. deep, 1s. would not pay for 200, in consequence of the extra dead weight, and at 300 it must still be proportionately higher. The importance, therefore, of the dead weight being as light as possible cannot be overrated. We have to use in this neighbourhood chains, hemp and wire ropes; for the first a ⅝ chain is required to draw 10 cwts. from 200 fms.; the weight of this will be about 2 tons. A 4-in. wire-rope to draw 12 to 14 cwts. would weigh about 32 cwts., so that a saving under any circumstances would be effected by winding with the lighter and stronger material. I know, and feel there are sure to be plenty of objections to this in most of our Cornish mines; a great one we continually hear—"bad shafts." I am willing to grant that this is a serious objection, but are we prepared to admit that an important saving can be effected by their use? If so, it is clearly our duty to convert our "bad shafts" into good ones, where it is possible to carry it out. If we have to fix pitwork in a bad shaft, everyone joins in recommending to cut it abroad. I consider it equally as important that it should be cut abroad to a proper size, and as straight as possible for winding as for pumping. In the paper last read to you on Winding, an instance was given of the cost of drawing with single skips at South Frances Mine. To illustrate further what saving is effected by the use of skips even in bad shafts, I have the cost of drawing at Levant Mine, St. Just. Previous to the introduction of skips in these mines, three winding-engines were employed to effect the work now accomplished by one. A chain maker was constantly employed on the mine to manufacture chain, in addition to large quantities purchased, and the breakages were a constant source of danger and trouble, as they always are where we hear of chains and bad shafts. The shaft in which is the skip-road is of irregular underlie, at one time underlying north, and at another time south, so that it was a work of great trouble and expense to reduce the number of breaks or turns in the shaft to four. The depth is about 245 fms. from the surface. The cost of drawing is as follows, taken from the books of the mine:—

Coal, 30 tons per month, at 18s. per ton	£27 0 0	
Grease, oil, and hemp, per month	2 0 0	
Two enginemen	6 10 0	
Four fillers	13 10 0	
Four landers	11 10 0	£60 10 0
(There are two landers in each core, in consequence of the distance the ores have to be trammed from the pit's mouth. I do not think this fairly belongs to the calculation, although included.)		
The average cost of flat hemp ropes per year	£ 70 0 0	
Repairing the shaft is estimated at per year	120 0 0	
Three dozen skip-wheels per year	18 0 0	
Two skips worn out annually	14 8 0	
Shafts rolls worn out annually	5 0 0	
Nails and sundries	8 12 0	
	12)236 0 0	
Or, per month		19 13 4
		£80 3 4

Making a total monthly outlay of 80*l.* 3*s.* 4*d.*, no reduction or allowance being made for the worn-out materials, rope, and iron. The average quantity drawn per month is as near as possible 1400 tons, or at the rate of 13½d. to 14d. per ton, average depth 160 to 170 fms. Without in the least straining any part of the machinery, or any increase to the monthly wages of the men, the quantity drawn could be increased 50 per cent., and although 13½d. to 14d. represent the real cost, as above given, yet if there had been sufficient work to keep the machine "regularly" employed, the quantity drawn would be represented by at least 2000 tons, at a cost of 90*l.* per month, or 10¾d. per ton. There is a double skip-road in this instance. Previous to the introduction of skips at Levant, the expense of winding was at least double to what it now is, and although the cost in this instance may be thought high in comparison with some cases, yet when the expense caused by the number of turns in the shaft is taken into consideration, and the consequent wear and tear, the heavy consumption of fuel by the engine being of inadequate power, and that no allowance is made for worn-out materials, the comparison, on the whole, I consider to be very favourable. The first application, I believe, of the skip in this county was at the United Mines, in Gwennap, and, perhaps, nowhere has it been more successful; a double skip-road, a powerful engine, and a perpendicular shaft, it has accomplished the best results, and I do not think I am wrong in stating that for upwards of 200 fms. in depth the cost would not exceed 6d. per ton.

With regard to single skips, they should be strictly avoided. Where they are put in, the reason given is the smallness of the shaft. It is impossible to accomplish with a single skip anything like the results that can be obtained by double; more powerful engines are required, and the expense in every shape is much greater. Great South Tolgus is, I think, the most powerful winding-engine in this district, having a cylinder 32 in. diameter, and 9 ft. stroke. It works a drum 12 ft. diameter, making a revolution to each stroke of the engine, the rope used being round wire 4½ in. circumference. The shaft is principally perpendicular, remainder a regular underlie. When in full work 20 skips per hour may be accomplished, the skip containing 17 or 18 cwts. It is difficult to get at the exact cost, in consequence of the engine being used for other purposes, crushing, &c., but it is believed not to exceed 4d. per ton; but, as I stated at the commencement of this paper, in comparing this with deep mines, the cost will increase in more than a direct ratio. The wire-rope in use here has already been in use three years, and appears likely to last as much longer, and only two skips have been supplied during the same period, which are still at work.

These and the instances last brought before the notice of the Association—South Frances and Camborne Vean—may undoubtedly be classed as fair specimens of Cornish winding apparatus; but, comparing these with what is accomplished in the collieries, they seem insignificant. Feeling desirous of knowing what is accomplished in the North, through the introduction of Mr. John Taylor, jun., I have been favoured by Mr. John Lancaster, of the Kirkless Hall Collieries, near Wigan, with plans illustrating their mode of drawing, and the results they obtain—with a view of laying them before this Association, and I feel a pleasure in doing so. The drawings illustrate the most improved plans in use, and if it is not in our power to carry fully out in our mines similar plans, there are several points we can introduce to advantage. First, the principle of two cylinders coupled, working at quarter stroke on the same axis. It gives much greater regularity of motion, and the possibility of the engine being centred is entirely obviated. In the illustration furnished the cylinders are each 24 in. diameter, and 5 ft. stroke, vertical, direct acting, worked by link motion, and have "Wilson's" balanced slide-valves. Another point which has first struck my attention is the form of the drum, which is conical, so as to be compensating, and will be readily understood by a reference to the plan.

The ropes used are of steel, 1¼ diameter, and the nett quantity of coal drawn at each draft is 28 cwts. from a depth of 157⅓ fms. The load on the ropes is as follows:—

Coal	Tons	1	8	0
Four tubs		0	12	0
Cages		0	12	0
Ropes and chains		0	19	0
Total	Tons	3	11	0

Twenty-two strokes of the engine, done in 40 seconds, is all that is required for each draft. Mr. Lancaster also states, "the greatest quantity of coals which we have raised in a given time is 700 tons in 10 hours!" There are also plans of pit-head frame and engine-house, as well as large scale plans of the pit shaft arrangement, with the form of cages for drawing the coal. These are made of puddled steel, so as to get the greatest amount of strength with lightness.

The principle of drawing the tubs or wagons to surface, instead of filling and landing, is one I think which would receive more consideration than it has. I am well aware with our contracted shaft it would be generally impossible to do so, but, if the principle is correct, surely it would be worth our while to make our shafts equal to do so.

I think I have mentioned the three essential particulars in which the Cornish system differs from that adopted in the North, and with which they certainly accomplish most wonderful results.

Another use of the skips almost universally adopted in the collieries is that of raising and lowering the miners. In about half-a-dozen mines of the county we have man-engines for this purpose, but I see no reason why in those mines where there is not such a machine the skip might not be employed for that purpose, especially where a good sized perpendicular shaft or shafts of regular underlie permit the use of wire-ropes. It is notorious that where such do exist the miner will take every advantage he can to ride up, a privilege the agents (if I am correctly informed) frequently grant themselves the indulgence of.

J. HOCKING, jun.

Mr. LOAM felt much obliged to Mr. Hocking for introducing this question, for he (Mr. Loam) had long felt a great interest in it, had thought it over very carefully, and intended to have brought a paper on it before the Association, had opportunity and time permitted. The question had been brought before the meeting on one and two other occasions, and certain statements which had been made required to be well considered and thoroughly analysed, in order to test the accuracy of the principles we have in this county in drawing, with certain other principles. Two things had now been mentioned of great importance, and on these any discussion must depend—dead weight and single skips. Taking the best system of drawing in the county, with hempen flat ropes, we should find 1 ton of rope to the 100 fms., a skip weighing 6 cwts., and 1 ton of stuff, making altogether 3 tons for 100 fms. If they were going to introduce wire-rope, it appeared from Mr. Hocking, they might assume the weight to be one-half.

Mr. TWITE: He says "a ⅝ chain is required to draw 10 cwts. from 200 fms." The weight of this will be about 2 tons. A 4-in. wire-rope to draw 12 to 14 cwts. would weigh about 32 cwts.

Mr. LOAM said that wire-rope would be more than half the weight of hempen rope. He would take it at a half or two-thirds; in either case his argument stood good, especially if the cage was increased from 2½ up to 12 ft. In both cases it was not the intrinsic weight of the skip and chain, but the weight started on any given diameter drum. Increase the weight three times by an extra size drum; 2¼ tons multiplied by 2¼ diameter would give 6¾ tons; 2¼ tons multiplied by a 12-ft. drum would give 30 tons. In one case the strain upon the engine by a hempen rope on a small drum would be 6 tons, by a wire-rope on a large cage 30 tons. He knew it might be said that the descending rope and skip balanced the other. In practice that was not the case, for when the descending skip got too heavy the engineman had actually to throw steam against the engine to prevent the skip from descending too fast. The increasing velocity compelled the fast increase to run, or put on extra steam, to check it. It could be shown clearly that the wire-rope requires a much larger drum, causes an increased strain upon the engine, and gives no compensating power at all. As to cost, much must depend upon the constant use of the engine, and the cost of landers and fillers; whether they draw for 10, 14, or 24 hours; whether 1000 or 2000 tons, the quantity of work, and the time employed. Another question was as to the single skips. He was glad to hear Mr. H[illegible] speak of them as an increasing evil in this county. He spoke in the presence of [illegible] willing, no doubt, to admit the evil of single skips, but without enlarging their [illegible] they were unable to give effect to the mechanical necessities of double skips. It [illegible] obvious that the evil attached to a wire-rope, drawing over a very large drum, of [illegible] double weight, and of causing an excessive strain from the bottom of the deeper [illegible] without any compensating power whatever. Practical men would ensure their [illegible] nation in all cases where they really could do without them. In the best mines [illegible] were self acting, compensating cages, and flat ropes beginning with a 2½-ft. [illegible] cage. They must take into account the difference in the cost of coals at the [illegible] and in Cornwall. He had no statistics on that point either as to the cost of coal or [illegible] the amount of coal. And here he could not but regret the disuse of the practice of [illegible] ing on the performance of their machinery, for accurate reports would show the [illegible] the engines. However, coal cost here on an average 20s. per ton; in the collieries [illegible] more than 2s. or 2s. 6d. This was an important thing to be considered, and before [illegible] rushed away to a system they were not conversant with let them have all the [illegible] necessary to arrive at a correct judgment. He believed our system of drawing [illegible] superior to the system of the collieries as our system of pumping is superior to [illegible] Whereas the pumping of water does not cost us 2d. a ton to get it to the surface, our [illegible] cost us 1s. a ton. But stuff had to be moved at a rapid velocity until we overcame [illegible] excessive dead weight, while 50 tons of water, lifted by 200 tons of rods, would have [illegible] rods balanced up, and we only lift the real weight of the water. Until they arrived [illegible] some means of balancing the dead weight of drawing, the same as pumping, he despaired [illegible] of seeing a great reduction in the cost of drawing. But if they could not reduce it, [illegible] them not aggravate it by going on false principles, or by rushing into changes without [illegible] good basis to guide them.

Mr. R. T. GRYLLS said Mr. Hocking had intrusted his paper to him, [illegible] bring it before the meeting, but he did not, therefore, put himself forward as the champion of all his principles; but Mr. Hocking had taken the trouble to point out what [illegible] (Mr. Grylls) considered had not yet been noticed at this meeting or anywhere else, [illegible] a very important principle it was. They had been looking at the question of the [illegible] of drawing their stuff from the bottoms of mines, taking into account the expense [illegible] kibble-fillers, and so on; but Mr. Hocking had introduced a method by which they could get rid of kibble-fillers altogether. If the levels were properly constructed, and the shafts were ordinarily good, they might use tram-wagons as skips; the skips could be filled at the place where the ore was broken, brought out to the shafts, attached on, and sent up as skips. This is merely hinted at in the paper, but was a very important subject for consideration, and ought not to be neglected. He had thought of this very [illegible] quently. We are obliged to shape our wagons down to narrow bottoms to make the[illegible] fit our levels; but, were the levels ordinarily well made, or were new levels to be driven, nothing would be easier than to make tram-wagons serve the double purpose of tram-wagons and skips; filling once would answer for level and shaft, and we should save not merely the filler's salary, but likewise gain time—more important than the [illegible] themselves. The real question is—Whether there is any advantage in the wire-rope over the old chain or rope? It might be assumed as an admitted fact that the best system in Cornwall use the flat rope, and he hoped that ultimately the steel rope might supersede the wire-rope, and enabled them to get rid of more of this dead weight. Notwithstanding the able manner in which Mr. Loam had shown other disadvantages besides that of dead weight, this dead weight was a very great one; it was, beyond the [illegible] ratio involved by the length of rope, and caused a greater expense, if they drew deeper, than the ratio of a less depth. Having quoted an instance at the United Mines of the value of the flat rope, Mr. Grylls said care must be taken that if they gained more winding power they did not lose more time, and he was very glad Mr. Hocking's paper had caused a discussion, because Mr. Loam's critique would probably lead to still further elucidation.

Mr. CADY suggested that the Association should not lose sight of the accumulation of facts as to the size of engines, and the nature of the winding material, by which much light must be thrown on the question whether Mr. Loam or others were right.

Capt. TONKIN pointed out that Cornish mines were not under the same winding necessities as the coal mines. The latter had only one shaft, and up through that shaft must come the whole produce of the mine, and unless they hauled 5 and 10 times as much as we do their mines would be worth nothing. It was a matter of great importance to them to wind up an immense quantity of stuff. He contended for the antiquated method of drawing with the kibble chain, or rope, but he believed the method was never tasked to its utmost, and that 70—some people said even 100—per cent. more work might be done with the kibble, which might as well raise 1 ton of stuff as 6 or 7 cwts. Stuff had been raised 150 fms. at 1s. 1½d. a ton in Levant; but he knew an instance of stuff raised 250 fms. for 1s. a ton, and it might be done for still less, no doubt.

Mr. GRYLLS: Never in the world. (Laughter.)

Capt. TONKIN: If you will take the trouble to examine our mine books I will prove it to you. Mr. Hocking had stated that at the United Mines stuff had been raised at 6d. a ton, but a person who waited on the agents some time ago had ascertained that the expense was 1s. 5d. a ton, so that the charge must have since been greatly reduced, or Mr. Hocking was in error. At South Tolgus also it was said that drawing was done at 4d. a ton. Whether that was correct or not he could not say. No doubt great improvements might be made in winding stuff where there was plenty of time, and abundant shaft room.

THE NORTH STAFFORDSHIRE COAL FIELD.

BY JOHN BRADBURY, ESQ., JUN.

[Read before the Manchester Geological Society, April 29.]

The subject under consideration is one that I feel my inability to do justice to, and even were I capable of doing so, it would be difficult to group all the points of interest to be found in this singularly rich and highly interesting coal field into one paper. My apology for bringing the subject before you is the desire to give the Society all the reliable information that I am enabled to do concerning the peculiar position in which coal and the accompanying strata is to be found in some parts of the North Staffordshire coal field. From the high scientific and practical attainments of some of the members of this Society, it is to be hoped that the Society will be benefited in a geological point of view from the discussion following the reading of this paper, and that some of the members may be induced to give a full and detailed description of the subject which I so imperfectly bring before your notice. In consequence of the upper series of mines being unproductive in North Staffordshire, and, so far as I am aware, not workable in any case, the same opportunity has not presented itself for making observations as there otherwise would have been. I shall, therefore, content myself with stating, upon the authority of Mr. Hull, F.G.S., that the thickness of the permian strata and the new red sandstone, down to the middle series of coal measures is 1600 ft. The vertical section that I have prepared is from actual distances between the respective mines and the thickness of each of the mines as found under ordinary circumstances. The remarks upon the contortions and peculiarities of this coal field are bearing more particularly upon the district between Golden Hill and Biddulph.

The North Staffordshire coal field is irregular in form, but somewhat approaching a triangle. It is of very limited area, not exceeding 76 square miles. A line drawn through the centre of the coal field from Hartwell to Biddulph would be about 12 miles; this is the greatest distance between any two points, excepting the Cheadle coal field is included, when the width would be about 15 miles. The number and richness of the workable seams of coal and ironstone, however, somewhat compensate for its limited area, and place it in a favourable position when compared with others of greater area. At present it is only partially developed. It contains 39 workable seams of coal, varying in thickness from 11 ft. down to 12 inches. When coal seams are worked in connection with ironstone they are sometimes worked of the latter thickness: but in computing the number of workable seams I have not taken into account any below 2 feet in thickness, unless those that are being and have been worked. It is probable that at no very distant period some of the thin seams, now considered unworkable, may be worked to advantage, from the fact of being associated with beds of ironstone or fire-clay. The number of workable seams of ironstone is 12, varying in thickness from 7 feet and upwards down to 9 inches. The Red Shagg is the only seam of ironstone in this district, so far as I am aware, that has ever been found more than 5 feet in thickness, and it is only in exceptional cases that the Red Shagg exceeds that thickness; it has, however, been worked both in the neighbourhood of Tunstall and at the White Barn Colliery, near Newcastle, of greater thickness than that named: the aggregate thickness of the workable seams of coal in this coal field exceeds 156 ft., and that of the workable seams of ironstone 26 ft. 6 in. I have not taken into account the thickness of a seam of coal or ironstone where it has been more than an average thickness, but have aimed at being rather below the average. It is probable that improvements may be made in the smelting of iron ere long that will enable the manufacturer to use much of the poorer ironstone of the district that is now thrown away, or wasted in working.

The Cheadle district, which may be considered a detached portion of the same coal field, will not on the present occasion be brought before your notice, inasmuch as I am not sufficiently acquainted with the district to lay before you information of a reliable character. The new red sandstone and permian strata form the boundary of a considerable portion of this coal field. If we assume the figure of it to be a triangle, we shall have to trace its boundary from Mow Cop, which may be considered its apex, we shall [illegible] the north-western side the new red sandstone, which extends as far as Audley, at which point the permian strata commence, and run along the remaining distance of that side of the triangle, and across its base, until it is again joined by the new red sandstone at Cocknage Hill, near Blurton, which extends as far as Brookhouse Farm, near Wetley. The remaining portion of the boundary from Brookhouse to Mow Cop is of millstone grit. In the neighbourhood of Mow Cop the millstone grit is, probably, better adapted for the manufacturing of millstones than in any other part of the county. This trade appears to have been carried on in this locality almost from time immemorial, as several of the quarries bear unmistakeable traces of having been worked for such purposes before the use of powder was known, or even the primitive system of using lime for the blasting of rocks.

If the surrounding locality be viewed from the summit of Mow Cop, it will be easy to see that some immeasurable force has raised and contorted these rocks since they were deposited in their original position; and it is probable that the Cloud End, a hill of nearly equal height to Mow Cop, but separated by about two miles distance, may have joined at some distant period the Mow Cop range of hills. The deposit now forming Congleton Moss lies at the foot of the opening of this range of hills. It contains much timber, which is found lying in almost every direction, and buried a considerable depth: some of the trees are found with the soil in which they once grew still adhering to their roots. It appears as though the timber found buried in this moss had been washed from the higher grounds on which it had grown by some mighty torrent, that had carried away all before it. I believe it to be the general opinion, and one with which I agree, that the coal measures are to be found under the permian and new red sandstone rocks: if so, it is possible that by the aid of improved machinery, &c., connected with the working of mines, and more science being brought to bear upon the management of them, that a great area will be added to this coal field. Perhaps the time may be far distant, but its possibility, I think, can scarcely be doubted.

The blackband ironstone is the highest in position in the middle series of mines, and of more than average quality. It is worked at several of the collieries in the neighbourhood of Tunstall, and also at Fenton Park, Silverdale, near Newcastle, and other places in the same coal field. I fear it would occupy too much of your time were I to offer remarks upon each seam of coal and ironstone, I shall, therefore, confine my remarks to those that call for special attention.

The Red Shagg and Red Mine ironstone are both the richest and the cheapest to work of any in the whole series. The thickest coal seam is the Rowhurst: this coal is of very good quality, and is principally used for domestic purposes. The Bircherwood coal is highly valued, both for domestic purposes and for the burning of earthenware. It is a very clear-burning coal, and capable of producing an extraordinary amount of heat. The Bowling alley is a very strong coal, and very similar to the Splint coal of Scotland. It has been considered to be unsuited for the manufacture of pig-iron; however, recent experiments have proved that this seam, as found in Biddulph, is admirably adapted for such purposes, and is now extensively used by Mr. R. Heath, and others, in

...anufacture of pig-iron. It is also one of the best coals for locomotive purposes in ...strict. This seam often reposes upon a very strong rock, without the slightest ...rance of anything like fire-clay. The two Bambury mines, known by the differ...ames of 7-ft. and 8-ft., Banbury's, the Froggrow, New Pool, and other local names, ...tensively used for coking in some parts of the district, and are of good quality ...mestic purposes. The Holly Lane is the best house coal in the district, but free... The Ball Hurst coal is in two seams ... each, separated by a seam of soft dirt, 4 inches in thickness, but it often happens ...the top coal is altogether absent, or only 9 or 10 inches in thickness. The change ...place without any fault intervening, or the quality of the bottom seam being im... The Whinpenny coal, a seam about 3 feet in thickness, reposes upon a bed of ...tone, containing considerable siliceous matter, and possessing the property of smelt... at a very low temperature. The Silver Mine coal is the lowest workable seam ...middle series; there is, however, another mine, about 2 ft. in thickness, at 52 yds. ...the Silver mine. The distance between the lowest mine in the middle series and ...ermost in the lower series is 143 yards. The four-feet mine is the principal mine ...lower series; it is worked at Biddulph, and is there known by the name of ...rab Tree; it is a good coking coal, and well adapted for the manufacture of iron ...me of its stages. It was long thought by some of the pig-iron manufacturers ...ne of the coal of the North Staffordshire coal field was well adapted for manu...ng pig-iron, and to such an extent was this feeling carried against the local ...ne of the largest pig-iron manufacturers in the district purchased their coal ...Derbyshire and other places, although themselves working coal since proved to be ...ellent quality for such purposes. The Bowling Alley, Stoney 8-ft., and Rough ...ines are now acknowledged to be choice coal for the blast-furnaces; some of the ...seams are also used for such purpose. Until the opening of the Biddulph Valley ...ay most of the coal of this district was used in the neighbourhood of the Potteries ...e manufacture of earthenware, and iron in its various branches; since which time ...s have been afforded for bringing more coal into the market, as also for securing ...ter demand for it.

...ill next read over the general thicknesses of the seams of coal and ironstone, with ...stances between each, first remarking that the general correctness of it may be re...pon, although it may be found to differ with some of those already published, ...s the difference may have been occasioned from the sections being taken from ...t parts of the same coal field:—

	THICKNESS.		
	yd.	ft.	in.
Blackband ironstone	0	1	6
...rong bass	14	0	0
...ed Shagg ironstone, 4 ft.; ditto coal, 1 ft. 9 in.	1	2	9
...ck, binds, and bass	24	0	6
...ed Mine ironstone, 2 ft. 9 in.; ditto coal, 2 ft.	1	1	9
...etal, coal, and bass	10	1	6
...	1	0	8
...al	19	0	0
...ck, binds, coal, and bass	0	1	0
...al	25	0	6
...ck, linsey, and bass	0	1	6
...arrant, rock, and strong metal	24	0	0
...assey Mine ironstone, 4 ft.; ditto coal, 1 ft. 6 in.	1	2	6
...ittle Row coal	0	2	6
...eacock coal	1	1	3
...insey	14	0	0
...encroft Coal	1	0	6
...arrant and light metal	18	0	6
...obbin ironstone in bands	1	2	0
...ock binds	11	0	0
...reat Row coal	1	2	0
...ock, linsey, metal, and bass	28	0	0
...annel Row coal	2	0	0
...arrant, coal, metal, and bass	29	0	6
...ood Mine coal	0	1	3
...ennystone ironstone	0	2	0
...eep Mine ironstone, 2 ft.; ditto coal, 2 ft. 9 in.	1	1	9
...etal, linsey, and bass	24	0	0
...halkey Mine ironstone, 1 ft. 6 in.; ditto coal, 1 ft. 6 in.	1	0	0
...own Mine ironstone, 9 in.; ditto coal, 1 ft.	0	1	9
...arrant, coal, and bands of ironstone	18	1	0
...glow coal	0	2	6
...ock, and strong blue metal	38	0	0
...al	0	1	0
...arrant, linsey, and bass	34	0	0
...ttle coal	0	2	0
...ingbay coal	1	2	0
...al	12	0	0
...sty Mine ironstone	0	1	6
...ue metal, bands of ironstone, and bass	40	1	6
...lley Mine ironstone, 6 in.; ditto coal, 1 ft. 8 in.	1	0	2
...ey, coal, and metal	42	0	0
...al	0	1	6
...ck, metal, and bands of ironstone	10	0	0
...our-foot coal	1	0	0
...re-clay, bass, and metal	15	0	0
...owhurst coal	3	2	0
...ght metal, rock coal, and bass	27	0	0
...arwood ironstone, 1 ft.; ditto coal, 4 ft. 6 in.	1	2	6
...re-clay, rock, and metal	17	0	0
...nnel coal and Cannel	1	1	0
...ey metal and bass	21	0	6
...al	0	1	6
...ue metal, grey metal, and bass	29	0	6
...d, dark metal, grey rock, and bass	39	0	6
...al	0	1	0
...tal, rock, and linsey	21	0	0
...sey, metal, and black bass	27	2	0
...ckenwood coal	0	0	10
...ck, grey metal, and bass	20	0	6
...enfield coal	0	2	10
...ue metal	12	0	6
...al	0	2	0
... binds, metal, and bass	21	0	6
...al	0	1	9
...al, metal, grey rock, and bass	45	0	0
...ard coal	0	0	2
...ong linsey	0	1	6
...ck	11	0	6
...ard coal	0	1	10
...tal, coal, rock, and bass	25	0	0
...ugh Seven-feet coal	2	0	0
...arrant, coal, metal, and rock	55	0	0
...ney Eight-feet coal	2	1	0
...arrant, grey rock, and shale	31	1	6
...n-foot coal	2	0	6
...ck, metal and rock	30	0	0
...arrow Butts coal	0	1	0
...tal	15	0	0
...lly-lane coal	1	2	0
...ong grey rock and metal	55	0	0
...wling-alley coal	2	0	0
...arrant, metal, and rock	15	0	0
...erior coal in three seams	1	0	3
...al and warrant	13	0	0
...erior coal in four seams	1	0	7
...ck and black bass	48	0	0
...ossmans Mine coal	0	2	8
...tal, rock, and bass	38	0	0
...ow or Seven-feet Banbury	1	2	0
...ong rock and blue metal	38	0	0
...eshead coal	3	0	0
...rd and ironstone	31	0	0
...ekin Mine coal	0	2	3
...binds, rock, and strong metal	48	0	0
...hurst coal	2	0	0
...metal, and bass	20	0	0
...penny coal	1	0	0
...bass, and bands of ironstone	61	0	0
...Kiln-row coal	0	1	6
...and black bass	72	0	0
...lver Mine coal	1	1	9
...k bass and soft metal	52	0	0
...ta not known below this point	2	0	0
...al	143	0	0
...	0	1	5
...b Tree	47	0	0
"	1	1	0
...le-row coal	14	0	0
"	0	2	3
...rior coal	74	0	0
...	0	1	6

...ave previously remarked, much difference exists in the relative positions of the ...coal in a very slight area,—for instance, at the Stonetrough Colliery, near Mow ...Sparrow Butts and Holly Lane are so near to each other as to be worked to-...forming a mine nearly 10 feet in thickness, known by the name of the Two Row ...the adjoining collieries, Bradley Green and Childerplay, within 2 miles ...former, the mines are separated by 15 yards of strata. Nearly all the coal seams ...Mow Cop and Biddulph are of greater thickness in that locality than elsewhere; ...to lose their thickness in a gradual or wedge-like manner from this point ...centre of the coal field. From the high angle of inclination of the seams of coal ...locality, the yield per acre surface measure is enormous, in some instances ex-...of a seam of coal of the same thickness of an angle of 12°. I have ...[illegible] occasions, and in different collieries, as high as 82°. To me ...[illegible] for the human mind to conceive how such seams have been fashioned ...; for, if we accept the prevailing theory, that they are of vegetable origin, we ...take into consideration the fact that every seam of coal, if placed horizon-...occupy seven times its present surface area, in order to become bewildered ...in endeavouring to conceive how such a rank and luxurious ve-...could either have grown upon the spot or have been drifted together. If, on ...hand, we suppose them to have been raised into almost a vertical position by ...some power that our finite minds will not enable us to conceive, the same ...to comprehend the causes of the phenomena spoken of. ...called the rise and dip of the mines in this locality undergoes a gradual ...in what are technically called the "rearers," the angle of inclination of the ...from 40° to 82°, and the line of level or direction of strike is from 48° to 50° ...[illegible] the millstone grit dip the angle of inclination varies from 15° to ...[illegible] or direction of strike is about 3° from magnetic north and south. ...south-west of Mow Cop [illegible] 50° east south-east. The dip at Congle-...north-west, at the foot of the hill, the seams of coal ...[illegible] towards Cheshire and Staffordshire the changes ...the segment of a circle, as will be seen by reference to the plan before ...[illegible] is effected by a dislocation or abrupt termination of ...the direction in which they incline. It is sometimes the case that ...are worked upon both angles of inclination from one and the same shaft, and ...levels or headings form a segment of a circle of about two chains radius; in many instances the radius would be more than that named. Each seam of coal and its accompanying strata bears its respective distance to the others, where the change of angle and direction of dip takes place, consequently the curve formed by the turn again of the lower or outside mines is of greater radius than the uppermost or inner circle of mines. It is not unusual in this district to find the seams of coal so contorted or moved from their original position as to present the appearance of the same seam being folded together, and presenting two seams, each retaining its ordinary thickness, but separated by a few inches of dirt where the roof of the bottom mine should be. It is sometimes the case that three seams are found overlying one another in such a manner that little doubt can be entertained that it is the same seam of coal that has been forced one over the other by some extraordinary pressure or convulsion of the earth, but at what period of time and in what manner it has been accomplished I will not venture to hazard an opinion. These peculiarities often take place in close contiguity to faults or dislocation of the strata. Some portion of the coal field contains numerous faults or dislocations, perhaps none more so than in the neighbourhood of Talk-o'th-Hill, although in the neighbourhood of Mow Cop, Harrisehead, and Biddulph, the faults are both numerous and of considerable magnitude. At the Stonetrough Colliery, Biddulph, in working the rearers, five faults are met with, on an average of 22 yards each, all downthrows to the south-west, in little over 1000 yards of line of level, whilst at the same colliery, upon the flat dip, a distance of nearly two miles, is found without any fault whatever. In Biddulph the faults are also numerous, and of every imaginable kind, many appearing to branch out in different directions from a main fault in almost as many different forms as the roots from a tree. Were it not that the seams of coal were numerous, and that a mine either above or below the one removed by dislocation is often brought into nearly the same position as the one removed, it would be questionable whether some of the collieries now worked could be worked to advantage.

In addition to the small faults mentioned there are several very large ones, one of which forms the boundary of the coal field near Longton, throwing in the new red sandstone on the east side. In the neighbourhood of Newcastle there is also another fault—a downthrow to the east; it is variously estimated to be from 350 to 400 yards; it passes a little to the east of Hanchurch, whilst another serves to form the boundary for some distance on the north-western side of the coal field. This fault ranges from near Audley to Astbury, near Mow Cop (assuming the limestone at Astbury to be the carboniferous): this fault is a downthrow to the north-west, at Astbury, equal to the whole thickness of the millstone-grit and coal measures, and a considerable portion of the new red sandstone. A somewhat peculiar circumstance in connection with the faults of this district is the fact that at Kidsgrove, Harecastle, or any of the collieries south-west of Harrisehead, most of the coal contains a considerable amount of bitumen, and almost every seam is of good quality for coking. To the north-east of that point they cease to contain anything like the same amount of bitumen, and the only mine that is at all adapted for making coke is the Crab Tree, or Four-feet Mine, in the lower series of mines. So suddenly does the change take place that the coal on one side of a 30-yards fault are remarkably adapted for coking, whilst on the other side much money has been spent in the fruitless effort of attempting to manufacture coke. As stated at the commencement, the points of interest to be found in this coal field are so numerous that I am compelled to pass over many that I might briefly have touched upon, had it not been for trespassing too long upon your time, and a desire to hear the views of some of those present who are better qualified than myself to explain the cause of some of the phenomena spoken of.

THE GEOLOGICAL FORMATION OF THE EARTH—No. XX.

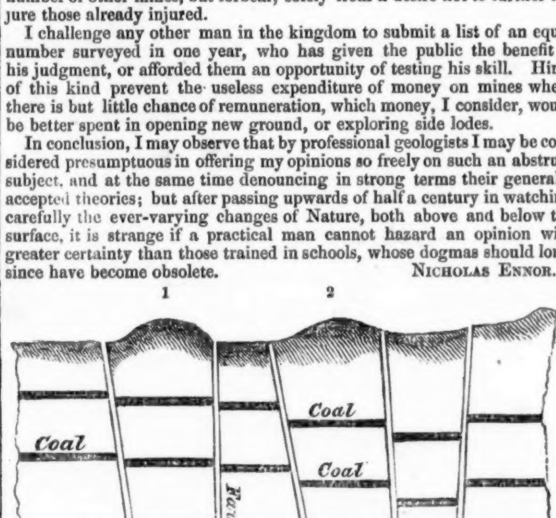
TO THE EDITOR OF THE MINING JOURNAL.

SIR,—My views on this subject having for the present been brought to a close, I republish my diagrams collectively in a single sheet, and am now prepared to discuss all or either of them, together with the views I have enunciated on their merits. I have struggled hard to glean a smattering of the Earth's interior laws, and have done what no other man has yet attempted—placed before the public the 144 mines I surveyed previous to, or early in, the year 1857, at which time I published a summary of the results that might be anticipated. The pamphlet has now been before the public close on five years, and a republication in the next Journal will afford its readers an opportunity of judging for themselves if I then evinced glaring errors of judgment. I might even show the enormous sums wasted on some of these mines since, and many that continue in a fair way of wasting a deal more. I should not hesitate to extend the list by an equal number of other mines, but forbear, solely from a desire not to further injure those already injured.

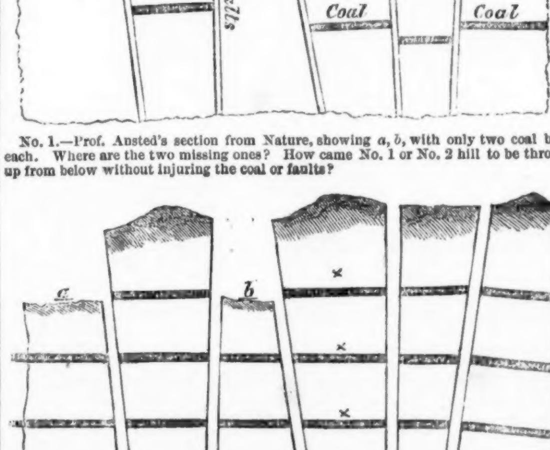
I challenge any other man in the kingdom to submit a list of an equal number surveyed in one year, who has given the public the benefit of his judgment, or afforded them an opportunity of testing his skill. Hints of this kind prevent the useless expenditure of money on mines where there is but little chance of remuneration, which money, I consider, would be better spent in opening new ground, or exploring side lodes.

In conclusion, I may observe that by professional geologists I may be considered presumptuous in offering my opinions so freely on such an abstruse subject, and at the same time denouncing in strong terms their generally accepted theories; but after passing upwards of half a century in watching carefully the ever-varying changes of Nature, both above and below the surface, it is strange if a practical man cannot hazard an opinion with greater certainty than those trained in schools, whose dogmas should long since have become obsolete.

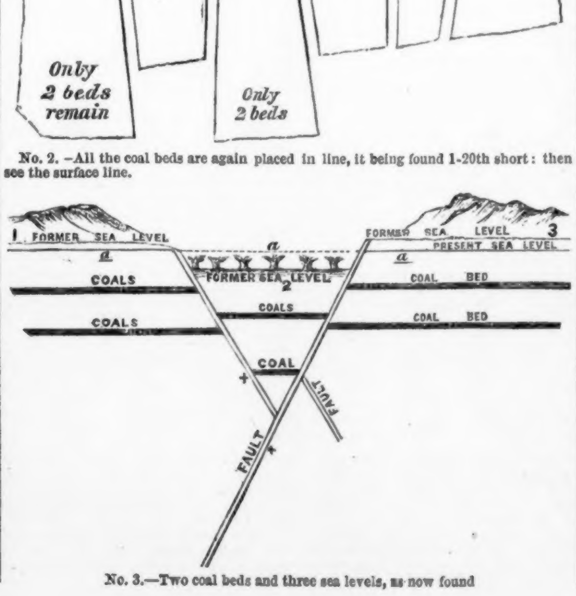
NICHOLAS ENNOR.



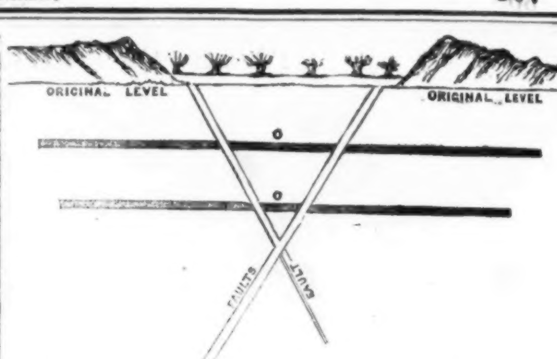
No. 1.—Prof. Ansted's section from Nature, showing *a*, *b*, with only two coal beds each. Where are the two missing ones? How came No. 1 or No. 2 hill to be thrown up from below without injuring the coal or faults?



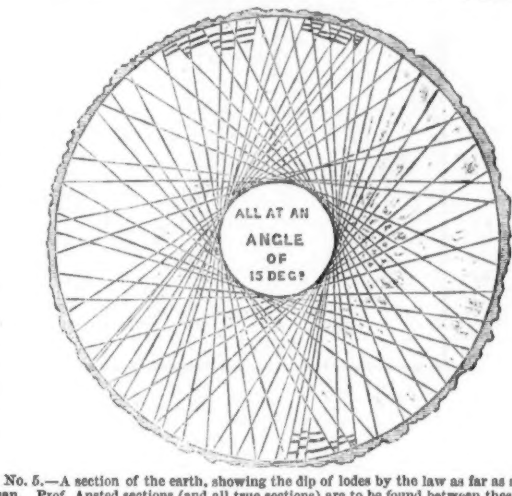
No. 2.—All the coal beds are again placed in line, it being found 1-20th short: then see the surface line.



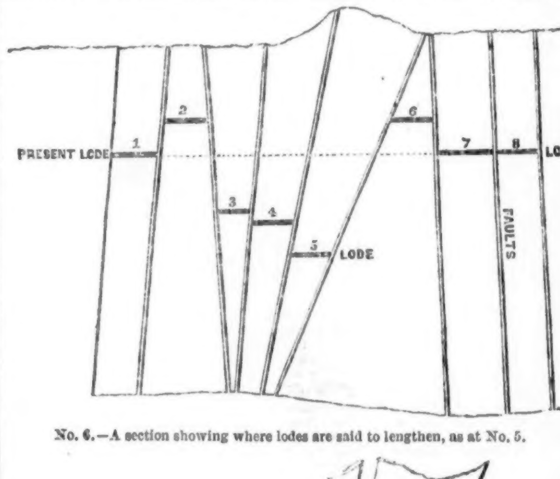
No. 3.—Two coal beds and three sea levels, as now found



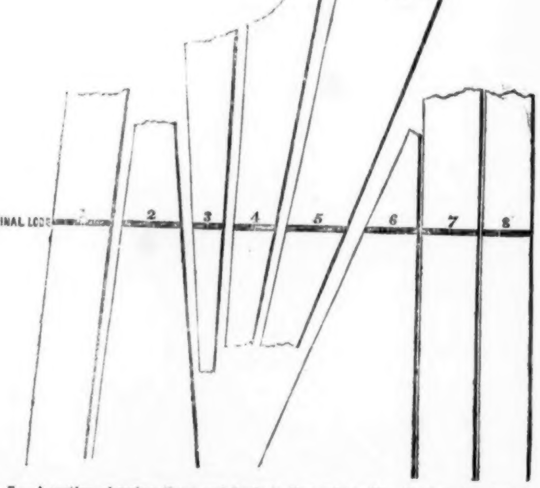
No. 4.—When all the coals are placed in line, all the sea levels then agree.



No. 5.—A section of the earth, showing the dip of lodes by the law as far as seen by man. Prof. Ansted sections (and all true sections) are to be found between these lines.



No. 6.—A section showing where lodes are said to lengthen, as at No. 5.



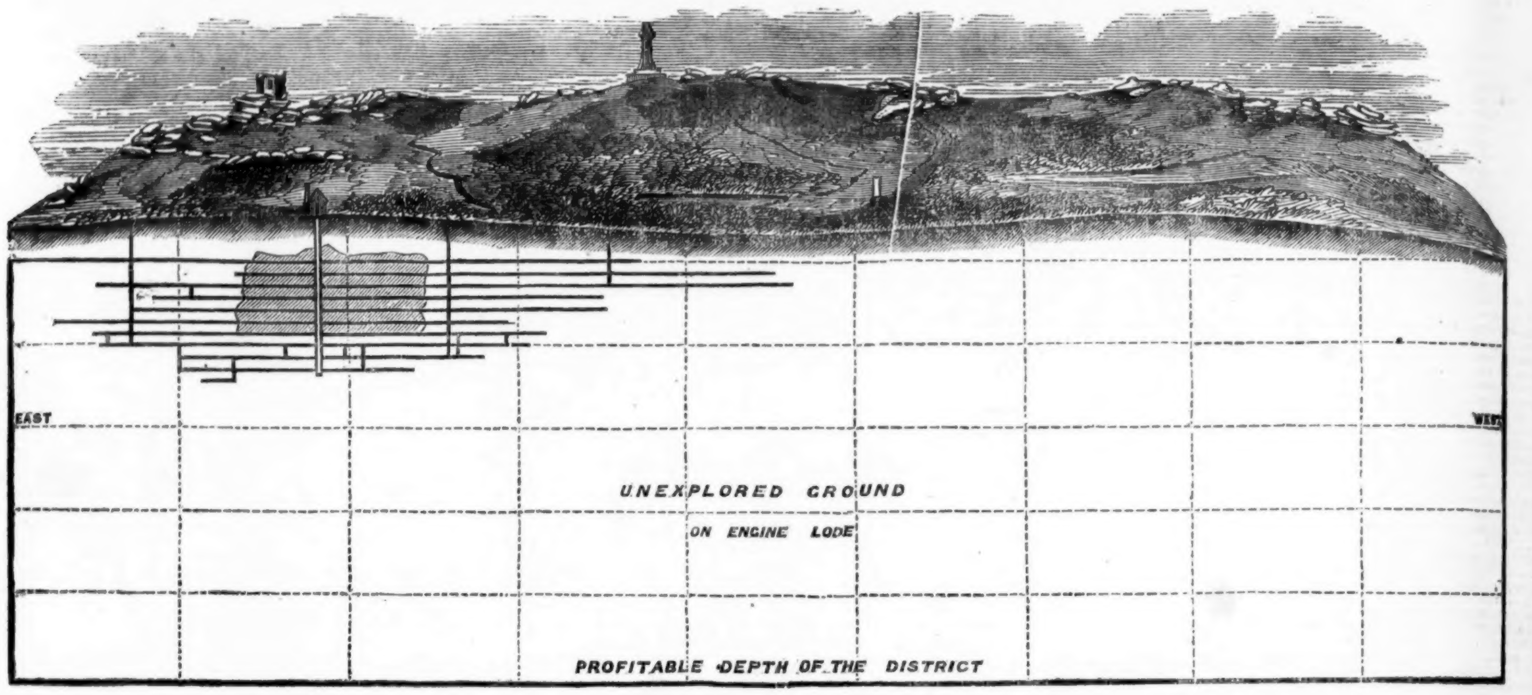
No. 7.—A section showing them put back in line, when (No. 5) it is found to be shortened the most of either piece.

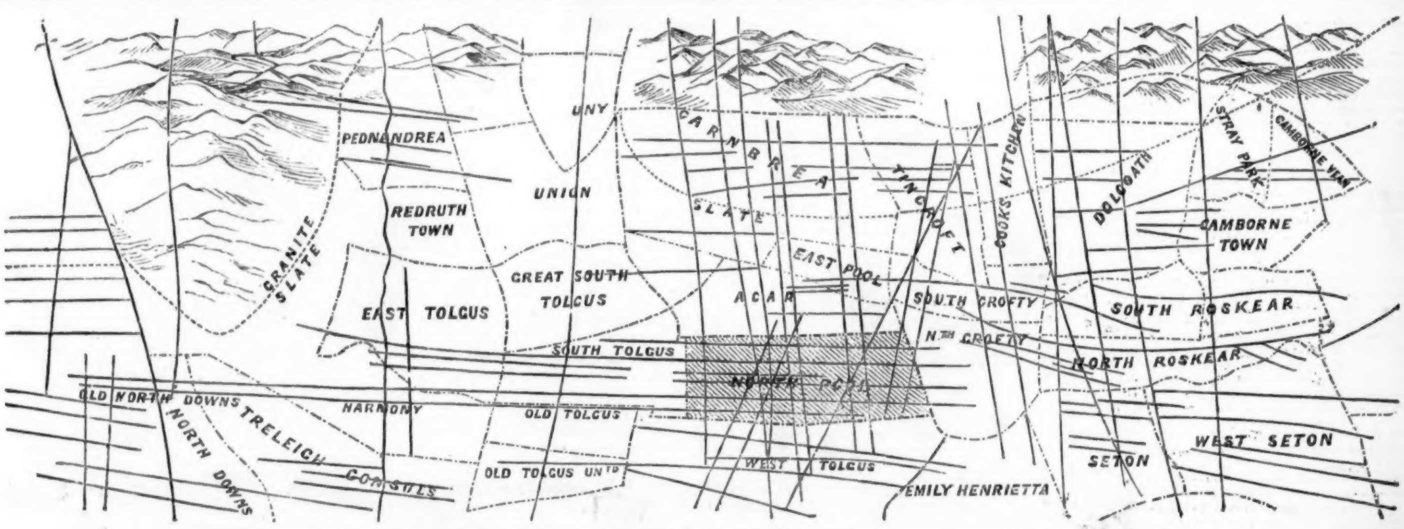
BOILER EXPLOSIONS.—The numerous accidents that occur from steam-boiler explosions, involving destruction of property and loss of life, imperatively demand that a strict enquiry should be instituted, with a view to discover the cause of these fearful catastrophes, and to devise preventive measures calculated to afford a proper remedy for the evil. The origin of these casualties often remains obscured in mystery, but in many instances they are attributable to ignorance, or may be traced to neglect. It happens that in some cases the risk might be obviated by means of a simple precaution, that can be easily adopted on all occasions, which consist in feeding the engines with "warm" instead of "cold" water whenever a supply is wanted. The fact has been ascertained by several experiments that cold water suddenly brought into immediate contact with caloric generates high electrical action, that is found to increase proportionately, according to the degree of intensity to which the articles become heated, and when the temperature of the water applied ranges below freezing point. Boilers in this condition of extreme heat and cold meeting are subject to violent shocks, from which influence they often burst like bomb-shells, and the fragments are scattered to a considerable distance. Other substances are affected in the same manner on a small scale. Paraffine lamps frequently explode in consequence of replenishing them with cold oil while heated from burning, an imprudent and dangerous practice, that cannot be too promptly abandoned. The expansive nature of steam differs essentially from explosive force, and produces results of a distinct kind. The peculiar qualities of steam, in a confined state, are exhibited by a constant and powerful pressure against the resisting iron boiler-plates, tubes, and cylinders by which it is enclosed exercising its active energies to open a passage for escape. The strength of the gigantic agent is derived from this source, which scientific ingenuity, combined with mechanical skill, has rendered subservient to control by a perfect contrivance that imparts motion to inert bodies through its instrumentality. A machine of this description is capable of being employed with safety to an unlimited extent for a variety of purposes, in a mode that has proved of incalculable value by abridging labour and aiding production. Judicious management forms an indispensable requisite for the regulation and guidance of the executive department, a prudential work that serves materially to ensure success in all pursuits, and diminishes the chances of failure incident to every enterprise. The primitive injunction to man, "Subdue the earth," appears to advance with rapid strides towards fulfilment, the process being principally conducted and mainly achieved through the wonderful operations of electricity and steam.—R. J. K.

PREPARING THE ENDS OF WELDED TUBES.—Mr. J. J. Russell, of Wednesbury, proposes, in place of heating the tubes as heretofore, to employ a bath of fluid lead, or other suitable metal, into which the ends of the welded tubes are immersed, and by the means they are readily and very uniformly heated to the extent desired, which cannot be the case when fire is used. The ends of the tubes when heated are forced into powdered coke, sand, &c., to exclude the atmosphere whilst they are becoming cold.

COOKING WITHOUT FIRE.—Mr. Kenney, of Rocksavage, has discovered and reduced to practice the art of cooking without fire. By a chemical agency, yet undivulged, he is able to heat and prepare for use every kind of vegetable product consumed by horses and cattle, preserving their nutritive and wholesome qualities even for a longer period than they are maintained by the ordinary method. The means employed are said to be cheap and simple, and the saving of labour very considerable.

PLAN OF THE NORTH POOL MINE, ILLOGAN, CORNWALL.





Statistics show that Carn Brea, Tincroft, Cook's Kitchen, and Dolcoath Mines have yielded upwards of	£900,000 profits.
Great South Tolgus, East Pool, Crofty, and South Roskear Mines	350,000 „
South Tolgus, North Pool, North Crofty, North Roskear, Seton, and West Seton Mines	500,000 „
Old North Downs, Harmony, and Old Tolgus Mines	180,000 „

North Pool is thus surrounded by rich mines, except the two infantile mines, West Tolgus and Wheal Agar, which are, however, being worked by the celebrated miners Messrs. Taylors and Joseph Lyle.

NORTH POOL MINING COMPANY (LIMITED).

Capital £24,000, in 6000 shares of £4 each.
Deposit, 2s. 6d. per share on application, and 2s. 6d. on allotment (or an order for shares with two references until the list is full).
The remainder by maximum quarterly instalments of 5s. per share, or less, as may be required for working the mine, of which due notice will be given.

DIRECTORS.
(Elected at a meeting of shareholders.)

W. R. PARKER, Esq., Manor House, Bexley, Kent (also director of Devon New Copper Mining Company).
J. TRUSCOTT, Esq., 23, Moorgate-street, London.
E. TURNER, Esq., Elizabeth Cottage, St. James's-road, Rotherhithe, London.
R. P. FAULL, Esq., Camborne, Cornwall.
F. SHAW TRUEMAN, Esq., Hazel Grove, Cheshire.

BANKERS—Messrs. Bolitho, Sons, and Co., Penzance, Cornwall; or to their account at Messrs. Ransoms and Co., bankers, London.
SOLICITOR—Frederick Wm. Snell, Esq., 1, George-street, Mansion House.
AUDITORS—Messrs. Cooper Brothers and Co., 13, George-street, Mansion House.

MANAGING AGENT.
Capt. Thomas Faull, late manager of Linares Mine, Spain, New Almaden Mine, California, and other home and foreign mines; now of Camborne, Cornwall.
ENGINEERS—Messrs. Mitchell and Jenkin, Redruth, Cornwall.
SECRETARY—J. S. Phillips.

OFFICES OF THE COMPANY—7, GEORGE YARD, LOMBARD STREET, LONDON, E.C.

The objects of this company are to raise capital and explore the very extensive remaining portion of this rich mineral vein, 1-45th part of which (as will be seen from the above section) has yielded from a first deposit the immense profit of 61,450*l.* in eight years, at a cost of £8180, having given thus far nearly 800 per cent. on the outlay, and produced more mineral than any mine of the district for a similar extent of ground.

There are, moreover, four side veins entirely unworked.

It is situated in the best part of Cornwall, between and on the same veins as the Tolguses eastward, and the Setons, Roskears, and Croftys westward, being in the midst of the six square miles that have yielded at least £6,000,000 profits, by an expenditure of about £600,000, and more than all the rest of Cornwall and Devon by tenfold outlay.

These plain facts should induce even those who are naturally averse to speculation to have a share in the development of this property, which from analogy should give immense profits. It may be asked, why was the mine abandoned? Which question also applies to the majority of the mines of this district, that have proved even richer in their second and third workings than in their first.

For example, Carn Brea Mines, about half a mile south, on parallel lodes, having given upwards of £240,000 by this working, from copper and tin, and will very probably become the greatest tin mine in the world in a few years, as its celebrated neighbour Dolcoath is now, under the copper. There are, however, three other joint reasons for North Pool having been stopped, which are well known in the locality, where fortunately the "rule" is to explore every fathom of ground, the "exception" not to do so, or there would not be a mine working in the four parishes.

A few hundred shares remain to be disposed of, for which, with further particulars, an immediate application should be made.

OFFICIAL REPORT.

Having been appointed the manager of the North Pool Mine, I have very carefully examined the property, to determine on the most expedient and best plan for the general exploration and development of the five lodes contained therein. I propose that a new shaft be sunk forthwith for the pumping engine, in the centre of the unexplored ground on the main lode, and midway between two very excellent and well-timbered shafts (sunk by the former company at a cost of several thousand pounds, to cut the lodes at these western points, but without completion of either object), the one called Bendigo shaft, which is 20 fms. deep, and 100 fms. from the western boundary; and the other Ballarat shaft, 48 fms. deep, or 24 fms. under adit, situated about 300 fms. from Bendigo shaft, 400 fms. from the west boundary, 150 fms. from the 36 and 48 fm. levels, and western whim shaft of the old mine. Whilst this new shaft is being sunk the engine should be erected, and flat-rods extended to the Ballarat shaft, to drain the water from the bottom, and therefrom extend the cross-cut to the main and side lodes, in one of which it is said there remains in the old mine, near this shaft, a course of copper ore 15 in. wide, worth from £15 to £20 per fm. By this distribution of forces a comparatively short time will enable us, in the 24 or 48 fm. levels, by six short cross-cuts, to cut the five lodes, 150 fms. apart, through the entire length of the sett, and disclose their values in 27 different places as yet unseen, opening up, if necessary, 54 ends for driving on the lodes, with eight available shafts for general use, when we may very reasonably expect to have much assistance from copper sales, and a most extensive, and I doubt not valuable, mine. I presume North Pool has given more proportionate profits for the ground worked, and, strange to say, still contains far more unwrought ground, than any mine in this rich district; therefore, situated as it is on the same and parallel veins of its immediate neighbours, and the best mines in the county, the greatest success may be very reasonably expected. In our necessary operations to accomplish the above work we shall utilise at least £6000 worth of labour, materials, and land, expended by the former company. In addition to the good and sterling opinions expressed by the managing agents of Camborne Vean, Carn Brea, North Roskear, North Crofty, South Frances, Great Retallack, Great Onslow Consols, and Wheal Kitty Mines, I beg to state that it is also the opinion of at least nine-tenths of the respectable miners of the locality that equally satisfactory results may be again obtained as have been realised; and as I have, with my family and friends, taken a large share in the adventure, I trust this expression of opinion will not be construed as an intention to mislead or deceive, for the greater would be the loss of THOMAS FAULL, Manager.

REPORTS.

REPORT OF CAPT. W. BOWDEN, MANAGER OF CAMBORNE VEAN, AND LATE AGENT AT NORTH POOL MINE.

Sept. 10, 1861.—I have been engaged in North Pool upwards of 11 years, during which period it made £61,000 profit from the adit to the 72, having an almost continuous bunch of copper ore for about 100 fms. in length. In this sett there are five distinct and well-defined lodes, in neither of which has any work of importance been done, excepting (from whence the large profits were made) on the engine lode. All the side lodes that have been slightly opened on produced ore, and showed indications of productiveness in depth. I should more particularly call the attention of those embarking in this speculation to the western part of this sett, on the engine and side lodes, which part was totally neglected by the late workers. The stratum and indications, as far as seen, are precisely similar to the old mine, where such large deposits of ore existed; and I, therefore, see no reason why you may not have as good a mine here as the old party had further east. This sett lies on the same run of lodes as Tolgus's on the east and Seton's on the west, and being in such a good locality, is a speculation rarely to be met with. A 50-in. pumping-engine will be sufficient to drain the mine to any moderate depth, and the outlay for machinery will be small compared to some mines in this district. In conclusion, I may say that as only about 200 fms. long have been explored, at a fair mining depth, and that as the sett is 900 fms. long, and contains five lodes, exceedingly little has yet been worked for this rich district, therefore it is highly probable that many other bunches of ore may be discovered that will, I have no doubt, lead to large profits; and I can highly recommend it to the mining community.

REPORT OF CAPT. J. DAW, MANAGER OF CARN BREA MINES, &c.

Sept. 12, 1861.—I beg to hand you my report of North Pool Mine. This mine is situated in the parish of Illogan, and is bounded on the east by South Tolgus, which is on the same run of lodes, and has given great profit to the adventurers, on the south by Wheal Agar and East Pool, on the west by North Crofty and Wheal Seton, and north by West Tolgus. The sett is very extensive, it being about 900 fms. long and 200 fms. wide, with four or five parallel lodes traversing its entire length. These are intersected by cross-courses and elvans, with patches of iron or greenstone. The lodes are engine lode, Evans's lode, great north lode, and south lode. Little has been done on any of these lodes, except the engine lode, which has been worked in the eastern part of the sett for about 200 fms. in length, and as deep as the 118 below adit. This part gave a profit to the adventurers of £61,000 in about eight years, and the ore was taken away from the 80 and above. For the future working I would call your attention to the long piece of unexplored ground in the western part of the sett, which is from 400 to 500 fms. long, and can be worked without interfering with the old mine. A few shafts or pits have been sunk on the backs of these lodes in the western ground, where the lodes are found to be large, and of a promising character. About 500 fms. east of the western boundary a shaft is sunk through the great north lode at 12 fms. below the surface, where it is large, and spotted throughout with copper ore. The sinking of this shaft in the country to the 24, under adit, is all that has been done on this lode, as it was not cut below the 12 from surface. Evans's lode has been intersected by a cross-cut north of the engine lode, in the 24, and some good copper ore has been returned from it. Looking at the situation of this mine, I consider it to be more than an ordinary speculation, having such a long piece of unexplored ground in this highly-mineralised district, and on lodes which have been so productive in the mines to the east and west, so I think it well worthy the attention of capitalists.

REPORT OF J. VIVIAN, MANAGER OF NORTH ROSKEAR, NORTH CROFTY, &c.

Sept. 11, 1861.—In reply to yours of yesterday, I am well acquainted with the district of North Pool Mine, and believe it to be a first-rate piece of mining ground.

REPORT OF W. PASCOE, MANAGER OF SOUTH FRANCES, &c.

July 26, 1861.—In reply to your kind favour of the 22d inst., respecting the above mine, I beg to say that I know but little about the old workings, but I believe with you that there is an extensive piece of untried ground to the north and west of the old mine which, in such a good locality, ought to be tried. I think you very fortunate to get the setts, and wish you every success in the undertaking.

REPORT OF W. H. REYNOLDS, MANAGER OF GREAT RETALLACK, WHEAL UNITY, &c., OF MESSRS. WATSON AND CUELL'S FIRM.

Sept. 3. 1861.—I am glad to find that you have secured the sett of North Pool Mine, and I know of no ground in the district lying idle that is so deserving of attention. It is an extensive sett, being, I believe, about 900 fms. long by 200 fms. wide, and traversed by at least five lodes, some of which I suppose to be those of South and Old Tolgus on the east, and the Setons on the west. Of these lodes one only has been tested to much depth, and from it I understand that upwards of £61,000 of profits were realised in eight years. The side lodes, I believe, have not been intersected below the 24, at which point they yielded some copper ore, and probably may be found very productive at deeper levels. The most important feature, however, is that there is upwards of half a mile of unexplored ground between the late workings and the Seton Mines; and, judging from the general productiveness of these lodes, it is highly probable that in this ground valuable discoveries may be made. When we look at the very rich locality in which this mine is situated, and the immense returns made from so small a portion of the sett, it certainly does appear that the prospects of the speculation are unusually good.

REPORT OF G. RICKARD, MANAGER OF GREAT ONSLOW CONSOLS.

Sept. 26, 1861.—I have considered the feasibility of North Pool sett as a speculation for further working, and, taking into consideration the fact that very extensive and profitable mines have been, or are being, worked at both ends of the property, the recent richness of the mine itself, the rich locality, and great extent of unexplored ground in the sett, there does not appear to me any sound reason why the unexplored portions of the engine lode, as well as the other lodes, may not prove profitably productive; and I consider if these lodes are properly worked there is a very fair chance of success.

REPORT FROM M. EDWARDS, LATE MANAGER OF WHEAL KITTY.

Sept. 3, 1861.—The extensive and valuable mining property of North Pool is situated in the parish of Illogan, and is closely surrounded on the south, east, and west, by some of the most productive and profitable mines in Cornwall. The sett is about 800 fms. in length from east to west, and 200 fathoms wide from north to south. It contains four or five copper lodes within its limits, only one of which, towards the eastern end of the sett, was sunk on to a depth of 118 fathoms below adit, and from this limited extent of workings sufficient ore was raised at and above the 72 to pay back upwards of £61,000 in dividends to the adventurers. From this lode a cross-cut has been driven north in the 24, which has intersected three other most promising lodes successively, being, it is stated, of good size, and produced rich stones of copper ore, which in general in this district is as much as can be expected at that depth; little or nothing, however, has been done in them, although they presented most encouraging prospects. They appear to possess all the elements of success, and are available to a new company. These lodes, however, run the entire length of the sett, and as there is a large amount of unexplored ground in the western part of it, I would strongly recommend you to commence operations there, open on the lodes, and give it a vigorous and spirited trial. For this purpose only a moderate amount of capital will be required, which, in my opinion, will not fail, if judiciously laid out, to make a lasting and profitable mine.

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